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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/071,106	02/08/2002	Robert L. Wood	9134-59	1445

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EXAMINER	
MARTINEZ, JOSEPH P	

ART UNIT	PAPER NUMBER
2873	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/071,106	Applicant(s) WOOD, ROBERT L.	
	Examiner Joseph Martinez	Art Unit 2873	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 February 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 February 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Response to Amendment

Applicant's arguments, see p. 4-16 of amendment, filed 2-16-03, with respect to the rejection(s)of claim(s) 1-20 under 35 USC 102 and 103 have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5, 17 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gloeckner et al. (6455841).

Re claim 1, Gloeckner et al. teach for example, a microelectromechanical (MEM) module comprising: a plurality of MEM device substrates (substrate 125, fig. 1A), each of which includes at least one MEM device (micromirrors 120, fig. 1A) thereon; a base substrate (substrate 920, fig. 9A) including a face, but fail to implicitly teach a mounting structure. However, Gloeckner et al. further teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49). Therefore, it would have been obvious to one of ordinary skill in the art to provide a mounting structure in order to properly affix the optomechanical switching cells to a substrate.

Re claim 17, Gloeckner et al. teach for example, a method of fabricating a movable microeoectromechanical (MEM) structure comprising: etching an array of features in a silicon substrate, forming a pad comprising silicon dioxide in the silicon substrate; forming a movable MEM structure on the pad; and removing the pad to release the movable MEM structure, but fail to implicitly teach partially thermally oxidizing the array of features. However, it is well known in the art of manufacturing MEM devices to utilize thermal oxidation in order to provide good uniformity of thickness of etch -resistant layers.

Re claim 21, Gloeckner et al. teach for example, an optical cross-connect switch (micromirrors 1220, fig. 12) comprising: a plurality of optical cross-connect switch substrates (substrate 920, fig. 9A), each of which includes an M row by N column optical cross-connect switch thereon (fig. 9A); a base substrate (square boundary encompassing micromirrors 1220, integrated microlenses and input and output fibers, not labeled, fig. 12) including a face; configured to mount the plurality of optical cross-connect switch substrates on the face in an array of R rows and S columns on the face to thereby provide an optical cross-connect switch of M x R rows and N x S columns (col. 11, ln. 60-63), but fail to implicitly teach a mounting structure. However, Gloeckner et al. further teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49). Therefore, it would have been obvious to one of ordinary skill in the art to provide a mounting structure in order to properly affix the optomechanical switching cells to a substrate.

Re claims 2-3 and 22, supra claims 1 and 21, respectively. Gloeckner et al. further teach for example, a MEM module or optical cross-connect switch wherein each of the MEM device substrates includes an array of M rows and N columns of MEM devices thereon and in an array

of R rows and S columns on the face to thereby provide a tiled array of M x R rows and N x S columns of the MEM devices in the MEM module, wherein the MEM devices comprise movable MEM mirrors, but fail to implicitly teach a mounting structure. However, Gloeckner et al. further teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49). Therefore, it would have been obvious to one of ordinary skill in the art to provide a mounting structure in order to properly affix the optomechanical switching cells to a substrate.

Re claims 4 and 23, supra claims 2 and 21, respectively. Gloeckner et al. teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49), but fail to implicitly teach a mounting structure comprises a plurality of solder bumps that are configured to mount the plurality of MEM device or optical cross-connect switch substrates on the face. Official Notice taken. It is well known in the art of MEM devices to use solder bumps to mechanically and electrically secure a device to a substrate.

Re claim 5, supra claim 4. Gloeckner et al. further teach for example, the MEM device substrate (substrate 920, fig. 9A) includes first (side shown in fig. 9A) and second (opposite side shown in fig. 9A) opposing faces, wherein the at least one MEM device (optomechanical switching cells 930, fig. 9A) is adjacent the first face and remote from the second face and wherein the first faces of the MEM device substrates are adjacent the face of the base substrate.

Claims 6-16, 18-20 and 24-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gloeckner et al. in view of Neukermans et al. (5629790).

Re claims 6 and 24, Gloeckner et al. further teach for example, a microelectromechanical (MEM) mirror module or optical cross-connect switch comprising: a plurality of MEM or optical cross-connect mirror substrates, each of which includes a mirror, a base substrate including a

face; configured to mount the frames of the plurality of MEM device substrates on the face, but fail to implicitly teach a mirror comprising monocrystalline silicon, a frame comprising monocrystalline silicon that is spaced apart from and at least partially surrounds the mirror and at least two hinges between the mirror and the frame and a mounting structure. However, Neukermans et al. teach for example, a mirror (mirror 70, fig. 3c) comprising monocrystalline silicon (col. 5, ln. 5-8), a frame (frame 207, figs. 12a and 12b) comprising monocrystalline silicon (col. 5, ln. 5-8) that is spaced apart from and at least partially surrounds the mirror (col. 5, ln. 18-21) and at least two hinges (torsion bars 205 and 209, figs. 12a and 12b) between the mirror and the frame and a mounting structure (larger silicon section 211, figs. 12a and 12b). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Gloeckner et al. and Neukermans et al. in order to provide an optomechanical switching cell made of a two dimensional scanner made of monocrystalline silicon because the two dimensional scanner allows for scanning in an X and Y direction and the monocrystalline silicon provides a smooth, low defect density surface.

Re claims 7, 25 and 30, supra claims 6 and 24, respectively. Neukermans et al. further teach for example, the frame is a first frame (frame 207, figs. 12a and 12b), each of the MEM or optical cross-connect mirror substrates also comprising an insulator layer (col. 10, ln. 55-57) on the first frame, opposite the mounting structure, and a second frame (larger silicon section 211, figs. 12a and 12b) that is thicker than the first frame, on the insulator layer opposite the first frame (figs. 12a and 12b), wherein the second frame comprises monocrystalline silicon (col. 5, ln. 4-7).

Re claim 8, 26 and 31, supra claims 6 and 24, respectively. Neukermans et al. further teach for example, the mirror (inner mirror 203, figs. 12a and 12b) includes a pair of opposing faces and wherein each of the MEM or optical cross-connect mirror substrates further comprises a metal layer on each of the opposing faces of the mirrors (col. 6, ln. 22, ln. 26-27), wherein the metal layer comprises a reflective metal layer (col. 6, ln. 63-65).

Re claims 9 and 27, supra claims 8 and 24, respectively. Gloeckner et al. teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49), but fail to implicitly teach a mounting structure comprises a plurality of solder bumps that are configured to mount the plurality of MEM or optical cross-connect switch device substrates on the face. Official Notice taken. It is well known in the art of MEM devices to use solder bumps to mechanically and electrically secure a device to a substrate.

Re claims 10 and 28, supra claims 9 and 27, respectively. Gloeckner et al. teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49), but fail to implicitly teach each of the MEM or optical cross-connect mirror substrates further comprises an underbump metallurgy between the frame and the solder bumps and wherein the underbump metallurgy and the metal layer on the MEM or optical cross-connect mirror substrate that is adjacent the base substrate both comprise a same metal. Official Notice taken. It is well known in the art of MEM devices to use underbump metallurgy to mechanically and electrically secure a device to a substrate.

Re claims 11 and 29, supra claims 6 and 24, respectively. Gloeckner et al. further teach for example, each of the MEM or optical cross-connect mirror substrates includes an array of M rows and N columns of MEM or optical cross-connect mirrors thereon and wherein the mounting

structure is configured to mount the plurality of MEM or optical cross-connect mirror substrates in an array of R rows and S columns on the face to thereby provide a tiled array of M x R rows and N x S columns of the MEM or optical cross-connect mirrors in the MEM or optical cross-connect switch mirror module.

Re claim 12, Gloeckner et al. teach for example, a method of fabricating a microelectromechanical (MEM) mirror module, but fail to implicitly teach providing a silicon-on-insulator substrate that includes a monocrystalline silicon layer on a bulk silicon substrate, with an insulator layer therebetween; fabricating at least two spaced apart pads in the monocrystalline silicon layer that extend through the monocrystalline silicon layer to the insulator layer; fabricating at least one hinge on each of the at least two spaced apart pads; defining a mirror and a frame that at least partially surrounds the mirror, in the monocrystalline silicon layer, such that the hinges bridge the mirror and the frame; and forming a metal layer on at least a portion of the mirror and at least a portion of the frame, opposite the insulator layer. However, Neukermans et al. teach for example, providing a silicon-on-insulator substrate (insulative substrate 221, figs. 12a and 12b) that includes a monocrystalline silicon layer (base layer 62, fig. 3a) on a bulk silicon substrate, with an insulator layer (silicon dioxide layer 64, fig. 3a) therebetween; fabricating at least two spaced apart pads in the monocrystalline silicon layer that extend through the monocrystalline silicon layer to the insulator layer (figs. 3, 3a, 3b and 3c, col. 7, ln. 40-47); fabricating at least one hinge (torsion bar 74, fig. 3c) on each of the at least two spaced apart pads; defining a mirror (mirror 7, fig. 3c) and a frame (frame 207, figs. 12a and 12b) that at least partially surrounds the mirror, in the monocrystalline silicon layer, such that the hinges bridge the mirror and the frame; and forming a metal layer on at least a portion of the

mirror and at least a portion of the frame, opposite the insulator layer (col. 6, ln. 63-65, col. 6, ln. 22). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Gloeckner et al. and Neukermans et al. in order to provide an optomechanical switching cell made of a two dimensional scanner made of monocrystalline silicon because the two dimensional scanner allows for scanning in an X and Y direction and the monocrystalline silicon provides a smooth, low defect density surface.

Re claim 13, supra claim 12. Gloeckner et al. further teach for example, a method further comprising: etching the bulk silicon substrate to expose the insulator layer adjacent the mirror and adjacent the pads, and etching the insulator layer adjacent the mirror and the pads to release the mirror and the hinges (col. 6, ln. 56-65).

Re claim 14, supra claim 13. Neukermans et al. further teach for example, the metal layer is a first metal layer, the method further comprising: forming a second metal layer on the mirror opposite the first metal layer (col. 6, ln. 22, ln. 63-65).

Re claim 15, supra claim 14. Gloeckner et al. further teach for example, mounting the MEM device on a base substrate, but fail to implicitly teach a silicon-on-insulator substrate and mounting with the hinges and the first metal layer adjacent the base substrate and the second metal layer remote from the base substrate. However, Neukermans et al. further teach for example, a silicon-on-insulator substrate and mounting with the hinges and the first metal layer adjacent the base substrate (substrate 221, figs. 12a and 12b) and the second metal layer remote from the base substrate. The office interprets both sides of mirror 203, figs. 12a and 12b are reflective on both sides and coated on both sides with thin layers of metal to enhance reflectivity. Therefore, the second metal layer is remote from the base substrate.

Re claim 16, supra claim 15. Gloeckner et al. teach for example, arranging optomechanical switching cells on a substrate (col. 10, ln. 48-49), but fail to implicitly teach the mounting comprises: flip-chip mounting the silicon-on-insulator substrate on the base substrate using a plurality of solder bumps. Official Notice taken. It is well known in the art of MEM devices to use solder bumps to mechanically and electrically secure a device to a substrate.

Re claims 18, supra claim 17. Gloeckner et al. teach for example, etching, but fails to implicitly teach etching an array of features in a silicon layer on an insulator layer on a substrate. However, Neukermans et al. further teach for example, etching an array of features in a silicon layer on an insulator layer (silicon dioxide layer 64, fig. 3a) on a substrate. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Gloeckner et al. and Neukermans et al. and provide a silicon layer on an insulator layer on a substrate, which greatly eases fabrication of mirror and hinges.

Re claim 19, supra claim 18. Neukermans et al. further teach for example, the features are between about 5 μm and about 25 μm thick (col. 5, ln. 1-2).

Re claim 20, supra claim 19. Neukermans et al. further teach for example, the removing comprises: etching the substrate adjacent the pad, etching the insulating layer adjacent the pad: and etching the pad, from the insulating layer that was removed to the movable MEM structure (col. 6, ln. 55-63).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Martinez whose telephone number is 703-305-0577. The examiner can normally be reached on M-F 7:00 AM to 3:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Georgia Epps can be reached on 703-308-4883. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7724 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-4883.

JPM
April 16, 2003

Hung Xuan Dang
Primary Examiner